

45. (Twice Amended) The method of claim 34, wherein the treating the first layer does not substantially change a composition of the first layer as detected by a fourier transform infrared analysis.

46. (Cancelled) A method of treating a carbon containing layer selected from the group consisting of organic polymeric materials, α C, α FC, SiCOH, and SiC deposited on a semiconductor substrate, comprising exposing the carbon containing layer to a plasma consisting essentially of an inert gas to increase adhesion and oxidation resistance of the carbon containing layer.

47. (Cancelled) The method of claim 46, wherein the inert gas is He.

48. (Amended) A method of treating a silicon carbide containing layer deposited on a semiconductor substrate, comprising exposing the silicon carbide containing layer to a plasma consisting essentially of an inert gas to increase adhesion and oxidation resistance of the silicon carbide containing layer.

49. (Cancelled) The method of claim 46, wherein the exposing the carbon containing layer to a plasma comprises flowing the inert gas into a processing chamber at a rate of about 100 to about 4000 sccm, establishing a chamber pressure between about 1 Torr to about 12 Torr, and applying an RF power density of from about 0.7 to about 11 W/in².

REMARKS

This is intended as a full and complete response to the Final Office Action dated November 5, 2002, having a shortened statutory period for response set to expire on February 5, 2003. Claims 24-26, 28, 30-38, 40, 42-49 are pending the application. Claims 24-26, 28, 30-38, 40, 42-49 were considered by the Examiner and stand rejected. Applicants have amended claims 24, 31-35, 45 and 48 to more clearly recite aspects of the invention. Applicants have cancelled claim 46-47 and 49, without prejudice.

Claims 31-33 and 46-49 stand rejected under 35 U.S.C. § 112, second paragraph. The Examiner has taken the position that “a plasma” recited in claims 33 and 49 has improper antecedent basis. Applicants have amended claim 33 to recite “the plasma” and cancelled claim 49, thereby obviating the Examiner’s rejection. The Examiner has taken the position that claims 31-32 recite improper antecedent basis. Applicants have amended claims 31-32 to recite that “the exposing the first layer to the plasma and the depositing the first layer are performed in a single processing chamber”, thereby obviating the Examiner’s rejection. The Examiner has taken the position that “improved” as recited in claim 46 is a relative term. Applicants have cancelled claim 46, thereby obviating the Examiner’s rejection. Accordingly, Applicants respectfully request the withdrawal of the rejections and allowance of the remaining claims.

Claim 45 stands rejected under 35 U.S.C. § 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Applicants have amended claim 45 to recite that “the treating the first layer does not substantially change a composition of the first layer as detected by a fourier transform infrared analysis”, thereby obviating the Examiner’s rejection. Accordingly, Applicants respectfully request withdrawal of the rejection and allowance of the claim.

Claims 46-47 and 49 stand rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over U.S. Patent No. 5,549,935 (*Nguyen, et al.*) Applicants have cancelled claims 46-47 and 49, thereby obviating the Examiner’s rejection.

Claims 24, 26, 28, 30-36, 38, 42, 45-47 and 49 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over *Nguyen, et al.* in view of German Patent No. 196 54 737 (*Itoh, et al.*) The Examiner has taken the position that *Itoh, et al.* teaches a multiple layer semiconductor device having an intermediate insulation layer containing Si, O, C and H. The Examiner further has taken the position that it would have been obvious to one of ordinary skill in the art, that the silicon containing layer of *Nguyen, et al.* could have been effectively supplied by the intermediate layer materials of *Itoh, et al.* because the intermediate layer is a Si oxide derivative and is desired to be used with a different

insulative layer deposited on it. Applicants traverse the rejection and respectfully submit that each of claims 24, 26, 28, 30-36, 38, 42 and 45 recite subject matter that is neither disclosed nor taught by the combination of *Nguyen, et al.* and *Itoh, et al.*

Nguyen, et al. teaches providing a silicon and/or silicide interlayer between a substrate and a subsequently applied polymeric fluorocarbon film. (See, column 2, lines 20-30.) For example, when the substrate is a silicon-containing material such as silicon nitride or silicon oxide, the silicon interlayer can be formed by ion bombardment, such as by argon, of the substrate to expose dangling silicon bonds. (See, column 2, lines 58-65.) However, *Nguyen, et al.* does not teach or suggest a method of processing a semiconductor substrate, including depositing a first layer on the semiconductor substrate, the first layer comprising a material selected from the group consisting of organic polymeric materials, α C, α FC, SiCOH, and SiC, exposing the first layer to a plasma consisting essentially of an inert gas and depositing a second layer comprising silicon over the first layer, as recited in amended claims 24 and 34.

Similarly, *Itoh, et al.* teaches depositing a first insulating film, e.g., SiO₂, on a substrate and then forming a number of conductors in the first insulation film. (See, translation pages 10-11.) Subsequently, an intermediate insulating film including Si, O, C and H is deposited on the number of conductors and a third insulation film, e.g., SiO₂, is formed on the intermediate insulation film. (See, translation pages 7, 10-11 and Figure 1.) The combination of *Nguyen, et al.* and *Itoh, et al.* does not teach, show, or suggest a method of processing a semiconductor substrate, comprising depositing a first layer on the semiconductor substrate, the first layer comprising a material selected from the group consisting of organic polymeric materials, α C, α FC, SiCOH, and SiC, exposing the first layer to a plasma consisting essentially of an inert gas, and depositing a second layer comprising silicon over the first layer, as recited in amended claims 24 and 34. Rather, combining the second and third insulating layers of *Itoh, et al.* with *Nguyen, et al.* frustrates the purpose of *Nguyen, et al.* of depositing a fluorocarbon on the silicide layer. Therefore, Applicants submit that each of independent claims 24 and 34, along with claims depending therefrom, are allowable over *Nguyen, et al.* and *Itoh, et al.* As such, reconsideration of the rejection is respectfully requested.

Claims 24, 26, 33-34, 36, 38, 45-47 and 49 stand rejected under 35 U.S.C. § 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,004,631 (*Mori*). The Examiner has taken the position that *Mori* teaches depositing a coating of an organic polymer or a spin on glass, that may contain hydrocarbon residues, on a substrate and subsequently treating that coating with a plasma. Applicants have amended independent claims 24 and 34 to recite depositing a second layer comprising silicon and cancelled claims 46-47 and 49. Therefore, Applicants respectfully submit that each of claim 24, 26, 33-34, 36, 38, and 45 recite subject matter that is neither disclosed nor taught by *Mori*.

Mori teaches forming a spin-on-glass film on a silicon substrate. (See, column 8, lines 52-53.) After the substrate is coated, the substrate is baked to provide a final composition substantially equal to SiO₂. (See, column 9, lines 33-38.) A thick portion of the spin-on-glass film formed on the edge of the substrate is then removed by an atmospheric plasma. (See, column 8, lines 53-58.) Supplying the atmospheric plasma to the spin-on-glass film first includes supplying helium to the processing chamber and then, while continuing to supply the helium gas, supplying a reactive gas, such as tetrafluoromethane gas, into the chamber. (See, column 11, lines 19-45.) *Mori* does not teach or suggest a second layer deposited on the spin-on glass comprising a silicide. Therefore, *Mori* does not teach or suggest a method of processing a semiconductor substrate, comprising deposition a first layer on the semiconductor substrate, the first layer comprising a material selected from the group consisting of organic polymeric materials, α C, α FC, SiCOH, and SiC, exposing the first layer to a plasma consisting essentially of an inert gas, and depositing a second layer comprising silicon over the first layer, as recited in amended claims 24 and 24. Therefore, Applicants submit that independent claims 24 and 24, along with claims depending therefrom, are allowable over *Mori*. As such, reconsideration of the rejection is respectfully requested.

Claims 24, 26, 28, 30-38, 40 and 42-49 stand rejected under 35 U.S.C. § 35 U.S.C. § 103(a) as being unpatentable over *Nguyen, et al.* in view of U.S. Patent No. 5,964,942 (*Tanabe, et al.*) The Examiner has taken the position that *Tanabe, et al.* shows the use of SiC as an intermediate on semiconductor substrate, prior to the

deposition of a carbonaceous layer of diamond. Applicants traverse the rejection and respectfully submit that each of claims 24, 26, 33-34, 36, 38, 45 and 48 recite subject matter that is neither disclosed nor taught by the combination of *Nguyen, et al.* and *Tanabe, et al.*

As discussed above, *Nguyen, et al.* teaches depositing a silicon containing film on a substrate, exposing the substrate to a plasma to form a silicide layer, and subsequently depositing a fluorocarbon film on the substrate. *Tanabe, et al.* teaches depositing a carbon containing intermediate layer on a substrate for reinforcing the interface between the substrate and a subsequently applied diamond film. (See, column 8, lines 62-65.) *Tanabe, et al.* does not supply a limitation missing in *Nguyen, et al.* of depositing a second layer comprising silicon on the first layer. Therefore, Applicants submit that each of independent claims 24, 34 and 48, along with claims depending therefrom, are allowable over *Nguyen, et al.* and *Tanabe, et al.* As such, reconsideration of the rejection is respectfully requested.

In conclusion, the references cited by the Examiner, neither alone nor in combination, teach, show, or suggest the method or apparatus of the present invention. Having addressed all issues set out in the office action, Applicants respectfully submit that the claims are in condition for allowance and respectfully request that the claims be allowed.

The prior art made of record is noted. However, it is believed that the secondary references are no more pertinent to the Applicants' disclosure than the primary references cited in the office action. Therefore, it is believed that a detailed discussion

of the secondary references is not deemed necessary for a full and complete response to this office action. Accordingly, allowance of the claims is respectfully requested.

Respectfully submitted,



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APPENDIX

24. (Amended) A method of processing a semiconductor substrate, comprising:
depositing a first layer on the semiconductor substrate, the first layer comprising a material selected from the group consisting of organic polymeric materials, α C, α FC, SiCOH, and SiC;
exposing the first layer to a plasma consisting essentially of an inert gas; and
depositing a second layer comprising silicon over the first layer.
31. (Twice Amended) The method of claim 24, wherein the exposing the first layer to the plasma [is performed in the same processing chamber as] and the depositing the first layer are performed in a single processing chamber.
32. (Twice Amended) The method of claim 25, wherein the exposing the first layer to the plasma [is performed in the same processing chamber as] and the depositing the first layer are performed in a single processing chamber.
33. (Twice Amended) The method of claim 26, wherein the first layer comprises silicon carbide and the exposing the first layer to [a] the plasma does not substantially change a composition of the first layer as detected by a fourier transform infrared analysis.
34. (Amended) A method of processing a semiconductor substrate, comprising:
depositing a first layer on a semiconductor substrate, the first layer comprising a material selected from the group consisting of SiCOH and SiC;
treating the first layer with a plasma consisting essentially of an inert gas; and
depositing a second layer comprising silicon over the first layer.
35. (Amended) The method of claim 34, wherein the treating the first layer [improves] increases the oxidation resistance of the first layer.

45. (Twice Amended) The method of claim 34, wherein the treating the first layer does not substantially change a composition of the first layer as detected by a fourier transform infrared analysis.

48. (Amended) A method of treating a [The method of claim 46, wherein the carbon containing layer comprises] silicon carbide containing layer deposited on a semiconductor substrate, comprising exposing the silicon carbide containing layer to a plasma consisting essentially of an inert gas to increase adhesion and oxidation resistance of the silicon carbide containing layer.



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